

Ship Self-Defense

Executive Summary

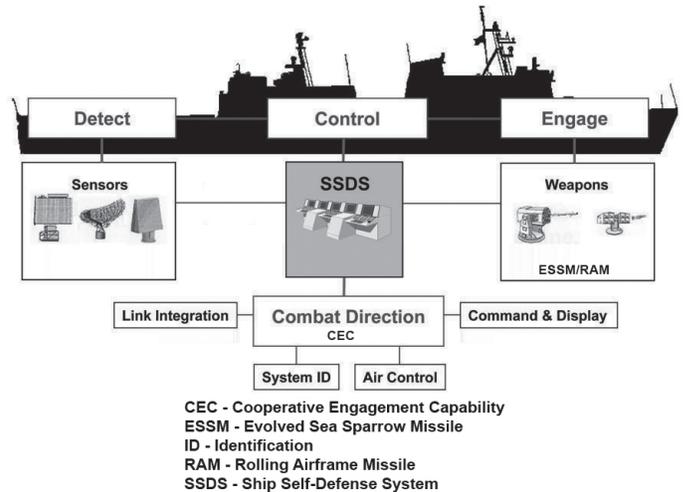
- The ship self-defense mission for aircraft carriers, destroyers, and amphibious warfare ships coordinates several legacy shipboard systems, as well as six major acquisition programs: Ship Self-Defense System (SSDS), Rolling Airframe Missile (RAM), Evolved SeaSparrow Missile (ESSM), Cooperative Engagement Capability (CEC), Surface Electronic Warfare Improvement Program (SEWIP), and the Air and Missile Defense Radar (AMDR). These comprise a self-defense capability for in-service ships, as well as the LPD-17, LHA-6, DDG 51 Flight III, and CVN-78 ship classes still in acquisition.
- The Navy successfully completed the first phase of the RAM Block 2 IOT&E with four missile firings in May 2013 from the Self-Defense Test Ship (SDTS).
- While the integration of sensor and weapon systems with the command and decision system enhances the ships' self-defense capability over non-integrated combat systems, the Navy has not successfully demonstrated the ability to effectively complete the self-defense mission against the types of threats and threat scenarios for which the overall system was designed.
- The Navy must complete the currently planned operational test programs and conduct additional testing to demonstrate the correction of significant deficiencies with SSDS Mk 2, RAM, ESSM, CEC, and legacy ship self-defense combat system elements.

System

Surface ship self-defense is addressed by several legacy combat system elements (ship class-dependent) and five acquisition programs: SSDS, RAM, ESSM, CEC, SEWIP, and AMDR.

SSDS

- SSDS is a local area network that uses open computer architecture and standard Navy displays to integrate a surface ship's sensors and weapons systems to provide an automated detect-track-engage sequence for ship self-defense. SSDS Mk 1 is the command and control system for LSD-41/49 class ships.
- SSDS Mk 2 has six variants:
 - Mod 1, used in CVN-68 class aircraft carriers
 - Mod 2, used in LPD-17 class amphibious ships
 - Mod 3, used in LHD-7/8 class amphibious ships
 - Mod 4, in development for LHA-6 class amphibious ships
 - Mod 5, in development for LSD-41/49 class amphibious ships
 - Mod 6, in development for CVN-78 class aircraft carriers



RAM

- The RAM, jointly developed by the United States and the Federal Republic of Germany, provides a short-range, lightweight, self-defense system to defeat Anti-Ship Cruise Missiles (ASCMs). RAM is currently installed in all aircraft carriers and amphibious ships (except LPD-4 class).
- There are three RAM variants:
 - RAM Block 0 uses dual mode, passive radio frequency/infrared guidance.
 - RAM Block 1A adds infrared guidance improvements to extend defense against non-radio-frequency-radiating ASCMs.
 - RAM Block 2 is in development and will extend the capability of RAM Block 1A against newer classes of ASCM threats.

ESSM

- The ESSM, cooperatively developed among 13 nations, is a medium-range, ship-launched self-defense guided missile designed to defeat ASCM, surface, and low-velocity air threats. The ESSM is currently installed on DDG 51 Flight IIA destroyers, as well as CVN-68 class aircraft carriers equipped with the SSDS Mk 2 Mod 1 Combat System. The Navy is planning for future ESSM installations in CG 47 class cruisers, LHA-6 class amphibious assault ships, CVN-78 class aircraft carriers, DDG 1000 class destroyers, and DDG 51 Flight III class destroyers.
- There are two variants of ESSM.
 - ESSM Block 1 is a semi-active radar-guided missile that is currently in-service.
 - ESSM Block 2 is in development and will have semi-active radar-guidance as well as active radar guidance.

CEC

- CEC is a sensor network with integrated fire control capability that is intended to significantly improve battle force air and missile defense capabilities by combining data from multiple battle force air search sensors on CEC-equipped units into a single, real-time, composite track picture. The two major hardware pieces are the Cooperative Engagement Processor, which collects and fuses radar data, and the Data Distribution System, which exchanges the Cooperative Engagement Processor data. CEC is an integrated component of, and serves as the primary air tracker for, SSDS Mk 2-equipped ships.
- There are four major variants of CEC:
 - The CEC USG-2 is used in selected Aegis cruisers and destroyers, LPD-17/LHD amphibious ships, and CVN-68 class aircraft carriers.
 - The CEC USG-2B, an improved version of the USG-2, is used in selected Aegis cruisers and destroyers.
 - The CEC USG-3A is used in the E-2C Hawkeye 2000 aircraft.
 - The CEC USG-3B is in development for use in the E-2D Advanced Hawkeye aircraft.
- SEWIP Block 2 is in development and will incorporate a new receiver antenna system intended to improve the AN/SLQ-32's passive EW capability.
- SEWIP Block 3 is in development and will incorporate a new transmitter antenna system intended to improve the AN/SLQ-32's active EW capability.

Mission

Naval Component Commanders use SSDS, RAM, ESSM, and CEC, as well as many legacy systems, to provide faster, more effective accomplishment of ship self-defense missions.

- Naval surface forces use SSDS to provide automated and integrated detect-to-engage ship self-defense capability against ASCM, air, and surface threats.
- Naval surface forces use RAM to provide a short-range hard kill engagement capability against ASCM threats.
- Naval surface forces use ESSM to provide a medium-range hard kill engagement capability against ASCM, surface, and low velocity air threats.
- Naval surface forces use CEC to provide accurate air and surface threat tracking data to SSDS.
- Naval surface forces will use AMDR as a primary sensor for simultaneous ballistic missile defense and air defense (to include self-defense) missions.
- Naval surface forces will use the SEWIP-improved AN/SLQ-32 as the primary EW sensor and weapons system for air defense (to include self-defense) missions.

AMDR

- The AMDR is the Navy's next generation radar system that is being developed to provide DDG 51 Flight III Destroyer combat systems with simultaneous sensor support of ballistic missile defense and air defense (to include self-defense) missions.

SEWIP

- The SEWIP is an evolutionary development program providing block upgrades to the AN/SLQ-32 Electronic Warfare (EW) System to address critical capability, integration, logistics, and performance deficiencies.
- There are three major SEWIP block upgrades:
 - SEWIP Block 1 replaced obsolete parts in the AN/SLQ-32 in addition to incorporation of a new, user-friendly operator console, an improved electronic emitter identification capability, and an embedded trainer.

Major Contractors

- SSDS (all variants): Raytheon – San Diego, California
- RAM and ESSM (all variants): Raytheon – Tucson, Arizona
- CEC (all variants): Raytheon – St. Petersburg, Florida
- AMDR: Raytheon – Dallas, Texas
- SEWIP
 - Block 1: General Dynamics Advanced Information Systems – Fair Lakes, Virginia
 - Block 2: Lockheed Martin – Syracuse, New York
 - Block 3: To be determined

Activity

- The Navy's Commander, Operational Test and Evaluation Force (COTF) completed the first phase of RAM Block 2 IOT&E testing and the first phase of SSDS Mk 2 Mod 4 FOT&E testing on the SDTS in May 2013 with four RAM Block 2 missile firings. Testing was conducted in accordance with a DOT&E-approved test plan.
- COTF continued planning for operational testing of the ship self-defense mission area during IOT&E of the RAM Block 2 and FOT&E of the SSDS Mk 2 Mod 4 and ESSM on the SDTS. The Navy plans to continue testing in March 2014.
- The Navy instituted the Fire Control Loop Improvement Program (FCLIP) to address a number of the ship self defense

deficiencies identified in the classified November 2012 DOT&E report to Congress on the ship self-defense mission area.

Assessment

- The RAM Block 2 firings, while successful, were not conducted with any FCLIP improvements. The initial FCLIP improvements are not planned for testing until March 2014. Many of the recommended improvements identified in the classified November 2012 DOT&E report to Congress will not be addressed until FY16.

NAVY PROGRAMS

- The test infrastructure remains inadequate to support self-defense testing on the DDG 51 Flight III Destroyers. The Navy has not planned or programmed funding for an unmanned, at-sea test capability to safely demonstrate the self-defense capabilities of the DDG 51 Flight III against anti-ship missile threats. The test capability must be in place by 2021 to support DDG 51 Flight III Destroyer Combat System and AMDR self-defense operational testing. The DDG 51 and AMDR programs are discussed in a separate section of this report.

Recommendations

- Status of Previous Recommendations. The Navy has satisfactorily completed some of the previous recommendations. The Navy has not resolved the following previous recommendations:
 1. Optimize SSDS Mk 2 weapon employment timelines to maximize weapon probability of kill.
 2. Develop a credible open-loop seeker subsonic ASCM surrogate target for ship self-defense combat system operational tests.
 3. Correct the identified SSDS Mk 2 software reliability deficiencies.
 4. Correct the identified SSDS Mk 2 training deficiencies.
 5. Develop and field deferred SSDS Mk 2 interfaces to the Global Command and Control System – Maritime and the TPX-42A(V) command and control systems.
 6. Continue to implement the Program Executive Office for Integrated Warfare Systems' plan for more robust, end-to-end systems engineering and associated developmental/operational testing of ship self-defense combat systems.
 7. Provide a capability to launch a raid of four supersonic sea-skimming targets at the Naval Air Warfare Center/ Weapons Division, Point Mugu, California, test range to support Test and Evaluation Master Plan-approved Air Warfare/Ship Self-Defense Enterprise testing planned for FY16.
 8. Improve the ability of legacy ship self-defense combat system sensor elements to detect threat surrogates used in specific ASCM raid types.
 9. Develop adequate and credible target resources for ship self-defense and EW operational testing.
 10. Continue to take action on the classified recommendations contained in the March 2011 DOT&E report to Congress on the ship self-defense mission area.
 11. Improve the SSDS Mk 2 integration with the Mk 9 Track Illuminators to better support ESSM engagements, as well as preventing the Mk 9 Track Illuminators from contributing to the composite track during certain threat raid types.
 12. Develop combat system improvements to increase the likelihood that ESSM and RAM will home on their intended targets.
 13. Conduct additional operational testing on the CVN-68 class once the ship is equipped with additional self-defense weapons. This additional testing will determine whether the additional weapons are sufficient to meet the ship's self-defense requirements.
 14. Develop an unmanned, at-sea self-defense test capability that will allow safe demonstration of the self-defense mission of the DDG 51 Flight III Destroyers, ESSM, and AMDR against anti-ship missile threats.
 15. Continue to take action on the classified recommendations contained in the November 2012 DOT&E report to Congress on the ship self-defense mission area.
- FY13 Recommendations. The Navy should:
 1. Continue planning for operational testing of the ship self-defense mission area during IOT&E of the RAM Block 2 and FOT&E of the SSDS Mk 2 Mod 4 and ESSM on the SDTS.
 2. Continue to implement and demonstrate with adequate operational testing the ship self-defense FCLIP improvements.
 3. Develop SDTS to permit testing the close-in self-defense capability of ships equipped with AMDR and the DDG 51 Flight III Combat System in FY21. (The DDG 51 and AMDR programs are discussed in a separate section of this report.)

NAVY PROGRAMS